Remarks

Claims 1 to 19 are being cancelled and replaced with new claims 20 to 49.

The various parts of the Office Action (and other matters, if any) are discussed below under appropriate headings.

Claim Rejections - 35 U.S.C. § 112

In response to the Examiner's indefiniteness rejection of previous claim 3 (new claim 22), new claim 22 has been amended to specify that the indicator material has an optical emission spectrum which varies in response to at least one other physical parameter. As the Examiner has noted, new claim 20 (previous claim 1) calls for the indicator material to have an optical emission spectrum which varies in response to a temperature, where temperature is a physical parameter. It is submitted that new claim 22 is consistent with new claim 20 in referring to at least one other physical parameter, thereby rendering moot the § 112 of claim 3, now claim 22.

In response to the Examiner's indefiniteness rejection of previous claim 9 (new claim 28), new claim 28 has been amended to omit reference to the indicator material being a "structure". New claim 28 now specifies that the indicator material comprises a compositionally-graded material, a composite material, or a multi-phase material. It is submitted that new claim 28 is consistent with new claim 20, thereby rendering moot the § 112 of claim 9, now claim 28.

In response to the Examiner's indefiniteness rejection of previous claim 10 (new claim 29), new claim 29 has been amended to omit reference to the indicator materials being layered structures. New claim 29 now specifies that each of the layers of the thermal barrier coating, where the thermal barrier coating comprises a layered structure, has different respective emission spectra. It is submitted that new claim 29 is consistent with new claim 20.

As regards previous claim 11 (new claim 30), it is submitted that this claim does not specify that the indicator material comprises a layered structure, as apparently interpreted by the Examiner, but rather that the thermal barrier coating comprises a layered structure. The reference to an indicator material is to the indicator material being included in a region of the thermal barrier coating, which, it is submitted, is consistent with new claim 20, thereby rendering moot the § 112 of claim 11, now claim 30.

Claim Rejections - 35 U.S.C. § 101

Regarding the Examiner's objection to previous claims 16 to 19, the new claims omit claims directed to use, and instead include claims (new claims 35 to 49) directed to a method comprising express method steps.

Claim Rejections - 35 U.S.C. § 102 and 103

New claim 20 is directed to a combination of previous claims 1, 17 and 18, and defines a machine having one or more components coated with a thermal barrier coating which comprises a mixture of at least a refractory material and an indicator material having an optical emission spectrum which varies in response to a temperature of the respective component, which machine comprises *inter alia* an analyzer for detecting at least a temperature of the one or more components by analysis of light collected from the one or more components.

New claim 32 is based on new claim 20, but, in being directed to a gas turbine engine, further includes the subject-matter of previous claim 13 to which the Examiner raised no objection. Accordingly, claim 32 is allowable.

New claim 35 is based on a combination of previous claims 16 to 18, where expressed as a method comprising express method steps. The claimed method requires *inter alia* the steps of providing a machine having one or more components coated with a thermal barrier coating which comprises a mixture of at least a refractory material and an indicator material having an optical emission spectrum which varies in response to a temperature of the respective component, and detecting at least a temperature of the one or more components by analysis of light collected from the one or more components.

New claim 47 is based on new claim 35, but, in being directed to a method of detecting at least a temperature of one or more components of a gas turbine engine, further includes the subject-matter of previous claim 13 to which the Examiner raised no objection. Claim 47 is thus allowable.

The Examiner has alleged that the subject-matter of previous claim 1 lacks novelty over the disclosure at column 8, lines 38 to 56 in US-5730528 (Allison *et al.*) regarding previously-identified thermally-sensitive phosphor materials.

Contrary to the Examiner's allegation, however, there has not been found any disclosure or suggestion of the use of those thermally-sensitive phosphor materials as a

thermal barrier coating for a machine component, a machine component coated with a coating of those thermally-sensitive phosphor materials, or a method of detecting a temperature of a machine component coated with a coating of those thermally-sensitive phosphor materials.

Indeed, Allison *et al.*, in relation to which the reference to those previously-identified thermally-sensitive phosphor materials is made, discloses (see in particular Figure 1) the provision of only a coated pad (12) on an article (14), such as the component of a turbine engine, which pad (12) is merely provided to provide a means of thermal measurement.

It is submitted that, without impermissibly performing an *ex post facto* analysis of the prior art, a person skilled in the art would not, when considering the teaching of Allison *et al.* as a whole, have understood the disclosure at column 8, lines 38 to 56 as teaching a thermal barrier coating for a machine component, a machine component coated with a coating of a material coating, or a method of detecting a temperature of a component coated with a coating of a material coating, particularly as a thermal barrier coating. It is submitted that a person skilled in the art would at best have considered Allison *et al.* as disclosing the provision of a pad of such thermally-sensitive phosphor materials on an article for temperature measurement.

Accordingly, it is submitted that the claimed invention is novel and unobvious over the disclosures of Allison *et al.*

In connection with the documents newly-cited by way of a supplementary IDS, the applicant would, for completeness and in the interests of expediency, make the following comment in relation to US-4,774,150 (Amano *et al.*).

Amano *et al.* discloses a thermal barrier coating which comprises a plurality or zirconia layers, each containing a luminous activator which generates a different fluorescent color, such that the degree of wear of the thermal barrier coating is detectable by observing the color generated when irradiated by UV radiation. While Amano *et al.* discloses a thermal barrier coating for coating a machine component, there is no disclosure or suggestion of utilizing the disclosed thermal barrier coating as a temperature indicator as now required by the claimed invention. In the thermal barrier coating of Amano *et al.*, the luminous activators in different layers are merely provided such as to fluoresce with different color on being irradiated, with the detected color enabling a determination of the extent of the erosion of the thermal barrier coating. The detected color is a structural effect, in being determined by the erosion, and hence

thickness, of the coating, and not a temperature effect, with each luminous activator having a predetermined color. As such, it is submitted that the claimed invention is clearly distinguished over the disclosures of Amano *et al.*

Conclusion

This application is now in condition for allowance and an early action to that effect is earnestly solicited.

Respectfully submitted,

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Don W. Bulson

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Amendments to the Claims

Claims 1-19 (cancelled)

20. (new) A machine having one or more internal components coated with a thermal barrier coating comprising a mixture of at least a refractory material and an indicator material having an optical emission spectrum which varies in response to a temperature of the respective component, the machine comprising:

a light source for directing an interrogating light beam onto the one or more components;

a light collector for collecting light from the one or more components; and

an analyzer for detecting at least a temperature of the one or more components by analysis of light collected from the one or more components.

21. (new) The machine according to claim 20, wherein the one or more components is coated with one or more priming layers over which the thermal barrier coating is coated.

22. (new) The machine according to claim 20, wherein the indicator material has an optical emission spectrum which varies in response to at least one other physical parameter of the respective component, and the analyzer is configured to detect the at least one other physical parameter of the one or more components by analysis of light collected from the one or more components.

23. (new) The machine according to claim 22, wherein the indicator material has an optical emission spectrum which varies in response to at least one physical parameter selected from the group consisting of a physical strain applied to at least a region of the one or more components, erosion of at least a region of the one or more components, and a physical stress of at least a region of the one or more components.

24. (new) The machine according to claim 20, wherein the refractory material is selected from the group consisting of yttria stabilised zirconia, yttria partially stabilised zirconia, and yttria aluminum garnet.

25. (new) The machine according to claim 20, wherein the indicator material is a phosphor material.

26. (new) The machine according to claim 20, wherein the indicator material comprises a rare earth dopant.

27. (new) The machine according to claim 26, wherein the indicator material comprises a dopant selected from the group consisting of terbium, europium, and dysprosium.

28. (new) The machine according to claim 20, wherein the indicator material comprises a compositionally-graded material, a composite material, or a multi-phase material.

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29. (new) The machine according to claim 20, wherein the thermal barrier coating comprises a layered structure, each of the layers including an indicator material having different respective emission spectra.

30. (new) The machine according to claim 20, wherein the thermal barrier coating comprises a layered structure of an outermost, substantially transparent region and a region including an indicator material optically interogatable through the substantially transparent region.

31. (new) The machine according to claim 20, wherein the machine is a combustion engine.

32. (new) A gas turbine engine having one or more internal components coated with a thermal barrier coating comprising a mixture of at least a refractory material and

an indicator material having an optical emission spectrum which varies in response to a temperature of the respective component, the gas turbine engine comprising:

a light source for directing an interrogating light beam onto the one or more components;

a light collector for collecting light from the one or more components; and

an analyzer for detecting at least a temperature of the one or more components by analysis of light collected from the one or more components.

33. (new) The gas turbine engine according to claim 32, wherein the one or more components is a turbine blade.

34. (new) The gas turbine engine according to claim 32, wherein the one or more components is a heat shield.

35. (new) A method of detecting at least a temperature of one or more components of a machine, comprising the steps of:

providing a machine having one or more internal components coated with a thermal barrier coating comprising a mixture of at least a refractory material and an indicator material having an optical emission spectrum which varies in response to a temperature of the respective component;

directing an interrogating light beam onto the one or more components;

collecting light from the one or more components; and

detecting at least a temperature of the one or more components by analysis of light collected from the one or more components.

36. (new) The method according to claim 35, wherein the component is coated with one or more priming layers over which the thermal barrier coating is coated.

37. (new) The method according to claim 35, wherein the indicator material has an optical emission spectrum which varies in response to at least one other physical parameter of the component.

38. (new) The method according to claim 37, wherein the indicator material has an optical emission spectrum which varies in response to at least one physical parameter selected from the group consisting of a physical strain applied to at least a region of the component, erosion of at least a region of the component, and a physical stress of at least a region of the component.

39. (new) The method according to claim 35, wherein the refractory material is selected from the group consisting of yttria stabilised zirconia, yttria partially stabilised zirconia, and yttria aluminium garnet.

40. (new) The method according to claim 35, wherein the indicator material is a phosphor material.

41. (new) The method according to claim 35, wherein the indicator material comprises a rare earth dopant.

B1 42. (new) The method according to claim 41, wherein the indicator material comprises a dopant selected from the group consisting of terbium, europium, and dysprosium.

43. (new) The method according to claim 35, wherein the indicator material comprises a compositionally-graded material, a composite material, or a multi-phase material.

44. (new) The method according to claim 35, wherein the thermal barrier coating comprises a layered structure, each of the layers including an indicator material having different respective emission spectra.

45. (new) The method according to claim 35, wherein the thermal barrier coating comprises a layered structure of an outermost, substantially transparent region and a region including an indicator material optically interogatable through the substantially transparent region.

46. (new) The method according to claim 35, wherein the component is a component of a combustion engine.

47. (new) A method of detecting at least a temperature of one or more components of a gas turbine engine, comprising the steps of:

providing a gas turbine engine having one or more internal components coated with a thermal barrier coating comprising a mixture of at least a refractory material and an indicator material having an optical emission spectrum which varies in response to a temperature of the respective component;

directing an interrogating light beam onto the one or more components;

collecting light from the one or more components; and

detecting at least a temperature of the one or more components by analysis of light collected from the one or more components.

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48. (new) The method according to claim 47, wherein the component is a turbine blade.

49. (new) The method according to claim 47, wherein the component is a heat shield.